

Legislative Audit Division

State of Montana



Report to the Legislature

May 2001

Performance Audit

Pavement Preservation Projects

Montana Department of Transportation (MDT)

MDT pavement preservation includes preventive activities such as chip sealing, crack filling, and pavement overlay. This review of the process used by the department to assign highway projects to district construction and maintenance staff concluded the following:

- < Decision-making for project assignment is reasonable.**
- < Review of costs is adequate for assignment decisions.**
- < Scope of work differences warrant two contracting approaches.**

Direct comments/inquiries to:

Legislative Audit Division

Room 160, State Capitol

PO Box 201705

Helena MT 59620-1705

01P-01

Help eliminate fraud, waste, and abuse in state government. Call the Fraud Hotline at 1-800-222-4446 statewide or 444-4446 in Helena.

PERFORMANCE AUDITS

Performance audits conducted by the Legislative Audit Division are designed to assess state government operations. From the audit work, a determination is made as to whether agencies and programs are accomplishing their purposes, and whether they can do so with greater efficiency and economy. The audit work is conducted in accordance with audit standards set forth by the United States General Accounting Office.

Members of the performance audit staff hold degrees in disciplines appropriate to the audit process. Areas of expertise include business and public administration, statistics, economics, accounting, logistics, computer science, and engineering.

Performance audits are performed at the request of the Legislative Audit Committee which is a bicameral and bipartisan standing committee of the Montana Legislature. The committee consists of six members of the Senate and six members of the House of Representatives.

MEMBERS OF THE LEGISLATIVE AUDIT COMMITTEE

Senator John Cobb
Senator Jim Elliott
Senator Dan Harrington
Senator Ken Miller
Senator Corey Stapleton
Senator Jon Tester

Representative Joe Balyeat
Representative Dee Brown
Representative Bill Eggers
Representative Hal Jacobson
Representative Jeff Pattison
Representative David Wanzonried

LEGISLATIVE AUDIT DIVISION

Scott A. Seacat, Legislative Auditor
John W. Northey, Legal Counsel
Tori Hunthausen, IT & Operations Manager



Deputy Legislative Auditors:
Jim Pellegrini, Performance Audit
James Gillett, Financial-Compliance Audit

May 2001

The Legislative Audit Committee
of the Montana State Legislature:

We conducted a performance audit of the process used by the Montana Department of Transportation (MDT) to assign pavement preservation projects to district construction and maintenance staff.

This report contains one recommendation to MDT for improving quality control testing and documentation for maintenance-designated pavement preservation projects. Written response from MDT is included at the end of the report.

We appreciate the cooperation and assistance provided during the audit by MDT central office officials, as well as staff assigned to the five transportation districts across the state.

Respectfully submitted,

(Signature on File)

Scott A. Seacat
Legislative Auditor

Legislative Audit Division

Performance Audit

Pavement Preservation Projects

Montana Department of Transportation (MDT)

Members of the audit staff involved in this audit were Lisa Blanford, Tom Cooper, and Jim Nelson.

Table of Contents

	List of Figures and Tables	Page iv
	Appointed and Administrative Officials	Page v
	Report Summary	Page S-1
Chapter I - Introduction	Introduction	Page 1
	Audit Objectives	Page 1
	Audit Scope and Methodologies	Page 2
	Scope Exclusions	Page 2
	Methodologies	Page 3
	Compliance	Page 4
Chapter II - Background and Funding	Introduction	Page 5
	Background	Page 5
	Department Organization	Page 6
	District Organization	Page 6
	Pavement Preservation Funding	Page 8
	Construction Pavement Preservation Funding	Page 9
	Maintenance Pavement Preservation Funding	Page 10
	Maintenance Funding Includes Federal Money	Page 11
	Expenditures Limited	Page 11
	Federal Contracting Requirements	Page 12
	Montana Use of Federal Funding for Maintenance is Unique	Page 12
	Maintenance Pavement Preservation is Split Between In-House and Contract	Page 12
	Summary: Use of Federal Funding for Maintenance Projects	Page 14
Chapter III - Pavement Preservation Decision-Making Process	Introduction	Page 15
	Eleven Decision-Making Factors	Page 15
	Performance Program Process	Page 18
	Objective #1: Are Similar Types of Projects Assigned to Construction and Maintenance Staff?	Page 18
	Construction-Administered Projects	Page 19

Table of Contents

	Maintenance-Administered Projects	Page 20
	Quality is Consistent	Page 20
	Objective #2: Is the Pavement Preservation Project	
	Assignment Process Reasonable?	Page 21
	Decision-Making Example	Page 21
	Options for Overlay	Page 22
	Different Factors - Different Decision	Page 22
	Trade-Off Between Construction and	
	Maintenance is Necessary	Page 22
	Objective #3: Is Cost Considered when Deciding to	
	Assign a Project?	Page 23
	Cost Factors Vary	Page 23
Chapter IV - Contract	Introduction	Page 25
Administration and	Statute Provides for Two Contract Options	Page 25
Management Information	Objective #4: Do Scope of Work Differences Warrant	
	the Use of Two Contracting Approaches?	Page 25
	Construction Contracts	Page 25
	Maintenance Contracts	Page 26
	Project Schedules	Page 27
	Objective #5: Are the Differences in Testing and Contract	
	Oversight Reasonable?	Page 28
	Project Cost	Page 28
	Construction Contract Administration and Oversight	Page 29
	Acceptance Testing for Construction Quality	
	Assurance	Page 30
	Maintenance Contract Administration	Page 30
	Project Oversight - Contractor Payment	Page 31
	On-Site Testing and Documentation Varied Between	
	Maintenance Areas	Page 32
	Objective #6: Do Controls Assure Pavement Management	
	System (PVMS) Data is Useful for Project Decisions?	Page 33
	Controls are Reasonable	Page 33
Department Response	Montana Department of Transportation	Page 37

List of Figures & Tables

Figure 1	Organizational Structure Department of Transportation	Page 7
Figure 2	Summary of Construction and Maintenance Contract Process	Page 27
Table 1	Completed Construction and Maintenance Pavement Preservation Projects (Fiscal Years 1998-99 and 1999-00)	Page 8
Table 2	Number and Type of Maintenance Pavement Preservation Projects (Fiscal Years 1998-99 and 1999-00)	Page 9
Table 3	Construction Pavement Preservation Funding (Fiscal Years 1998-99 through 2000-01)	Page 10
Table 4	Maintenance Pavement Preservation Expenditures (Fiscal Years 1997-98 through 1999-00)	Page 13
Table 5	Range of Costs for Construction and Maintenance Pavement Preservation Projects (Fiscal Years 1998-99 and 1999-00)	Page 29

Appointed and Administrative Officials

Montana Department of Transportation

Dave Galt, Director

Jim Currie, Deputy Director

John Blacker, Administrator, Maintenance Division

Gary Gilmore, Administrator, Engineering Division

Patricia Saindon, Administrator, Transportation Planning Division

Transportation Commission

District 1 - Dan Larson

District 2 - Shiell Anderson

District 3 - Dan Rice

District 4 - Nancy Espy

District 5 - Thorm Forseth

Introduction

The Legislative Audit Committee requested a performance audit to assess how the Montana Department of Transportation (MDT) determines when to use resources associated with construction and when to use resources associated with maintenance to complete pavement preservation work on highways. The responsibility for highway construction, repair, and maintenance is split between resources assigned to separate construction and maintenance functions within MDT.

Background

Pavement preservation is the term used by the department to define preventive highway work intended to increase the useful life of road segments. Primary highway pavement preservation activities include: crack filling, chip sealing, and pavement overlays. The department uses two approaches to complete pavement preservation projects. One approach involves the use of staff assigned to construction functions within the department. The other uses staff assigned to district maintenance activities. The scope of a pavement preservation project assigned to construction is usually more comprehensive than a project assigned to maintenance. For example, construction-designated projects might include re-construction of shoulder slope or elimination of curves. Maintenance pavement preservation projects are restricted to work on the existing road surface.

Pavement Preservation Funding

The department established an annual target of \$55 million for pavement preservation activities. This target was determined from analysis of the department's Pavement Management System (PvMS) data and is considered an average necessary to meet annual needs. Pavement preservation funding is designated for both construction and maintenance projects. The actual number of projects and the amount expended for pavement preservation varies from year to year depending on district highway needs, the status of project planning, project size/complexity, and available funding. In fiscal year 1999-00, construction completed 31 projects and maintenance completed 67.

Report Summary

Construction Pavement Preservation Funding

The total construction project budget for the department exceeds \$250 million for the year. The construction budget dedicated to pavement preservation averages around \$45 million each year. Most construction pavement preservation projects are funded through federal reimbursement. When federal funding is used, a state funding match ranging from eight to thirteen percent is required. In order to qualify for federal funding, projects must meet criteria outlined in a project nomination agreement jointly developed by the Federal Highway Administration (FHWA) and the department. Interstate system, national highway system, and Montana primary and secondary roads can all qualify for federal funding.

Maintenance Pavement Preservation Funding

The total maintenance budget is approximately \$75 million (including winter activities). For FY 1999-00, the department designated over \$14 million for maintenance pavement preservation activities. This funding was allocated to the five districts and eleven maintenance areas based on their review of road segment needs. Approximately \$9 of the \$14 million was state funding with the remainder federal. State funding for maintenance provides the department with the capability to respond to short notice requirements without the need to comply with federal contracting requirements.

Maintenance Funding Includes Federal Money

For the first time in fiscal year 1999-00, FHWA approved the use of federal funding for maintenance activities. According to department officials, the assignment of department responsibility over paved secondary roads by the 1999 Legislature resulted in a search for additional funding sources. The FHWA agreed to limited use of federal funding by maintenance and authorized the reimbursement of up to \$4.9 million. Department officials indicated expansion of the use of federal funding for maintenance projects beyond the amounts approved for FY 1999-00 and 2000-01 is not anticipated, because it would duplicate the process already in place that is used by construction and engineering.

Eleven Decision-making Factors

During the audit, we asked district officials how highway segments are identified for pavement preservation work and how the segments are selected for assignment to either construction or maintenance for administration and oversight. Based on their input, we developed a list of eleven factors used consistently by district and central office officials. We found consideration of the following eleven factors was part of the decision-making process in all five districts.

- < On-site Observation
- < Pavement Life Cycle Review
- < Pavement Management System Report
- < Planning Documents
- < Funding Availability
- < Project Cost
- < Environmental, Permits, and Right-of-Way
- < Geometric Re-design and Upgrades
- < Safety and Traffic Data
- < Construction and Maintenance Resource Capability
- < Local Government Influence

Audit Conclusions and Recommendation

In the following sections, we present conclusions for audit objectives. Our review of pavement preservation contracting and oversight procedures resulted in the development of one audit recommendation related to maintenance testing and documentation.

Objective #1: Are similar types of projects assigned to department construction and maintenance staff?

Conclusion We conclude construction and maintenance pavement preservation projects, though similar in appearance, are not the same. The scope of work differs and the factors used to make the assignment decision are not the same. The mission and goals of the construction and maintenance functions are different, which means the outcome of the projects is expected to be different.

Report Summary

Objective #2: Is the pavement preservation project assignment process reasonable?

Conclusion We conclude the decision-making process used by the department for pavement preservation projects is reasonable. The factors considered in the process allow staff to distinguish between projects warranting assignment to construction or to maintenance. Federal contracting and oversight requirements significantly influence decision-making.

Objective #3: Is cost considered when deciding to assign a project?

Conclusion We conclude the department considers cost, particularly for less complex projects such as chip sealing. However, as a result of our examination, we decided it is not necessary to expand review of cost beyond the current level, because for most projects the significance of the other ten decision-making factors is more important.

Objective #4: Do scope of work differences warrant the use of two contracting approaches?

Conclusion We conclude the differences between the scope of work between construction-designated and maintenance-designated pavement preservation projects warrants the use of two contracting approaches. Again, federal funding contract requirements dictate many of the differences.

Objective #5: Are the differences in testing and contracting oversight reasonable?

Conclusion We identified the primary differences between oversight of construction and maintenance pavement preservation projects as:

- < Type and number of tests per day (more for construction).
- < Volume of testing documentation (more for construction).
- < Project cost and associated cost of testing (higher for construction).
- < Potential risk to quality (higher for maintenance).
- < Contractor payment procedures (more detailed for construction).

Federal requirements dictate many of the construction contract testing requirements. Based on the expectations of construction pavement preservation projects compared to the projects assigned to maintenance, we conclude the differences in testing and oversight are reasonable.

Objective #6: Do controls assure Pavement Management System data is useful for project decision-making?

Conclusion We conclude data controls for PvMS appear to be reasonable. The information provided is an important part of the department's process for determining whether to assign projects to maintenance or construction. Neither district nor headquarters staff rely totally on PvMS for decisions; management officials consider the other ten decision-making factors before deciding on a treatment approach.

Audit Recommendation: Improve Maintenance Testing and Documentation

We noted maintenance files from district to district reflected a wide variety in the amount and types of testing and support documentation. Staff indicated the variation of testing from area to area was based on individual experience and background. Some regions use standard forms developed for construction project testing; others developed maintenance checklist forms; others maintain handwritten notes/diaries.

MDT officials indicated testing and documentation consistency is an area of concern, particularly as the department pursues more and more maintenance preventive work compared to the historical reactive (patching) approach. Our concern is either staff in one maintenance area are testing and documenting unnecessarily, or staff in another area are not providing enough verification of product quality. We believe the combination of expertise currently available in all eleven maintenance areas could jointly establish quality control and testing standards for projects based on the type of work, material specifications, and final product. Due to the size and complexity of most maintenance projects, we do not believe it is necessary for maintenance to test and document testing to the same degree as currently required for federally funded construction projects, because it would not be a cost-effective use of staff resources and funding. We recommend the Maintenance Division establish quality control and testing standards.

Chapter I - Introduction

Introduction

The Legislative Audit Committee requested a performance audit to assess how the Montana Department of Transportation (MDT) determines when to use resources associated with construction and when to use resources associated with maintenance to complete pavement preservation work on highways. The responsibility for highway construction, repair, and maintenance is split between resources assigned to separate construction and maintenance functions within MDT. The missions of these two entities are not the same; the exception is overlap in the area of pavement preservation work. Pavement preservation activities include: crack filling, chip sealing, and pavement overlays.

The audit issue was identified as an issue for further study in the March 1998 performance audit of MDT Construction Contract Administration (97P-05). The report proposed examining the decision-making process and criteria used by MDT to assign projects to district construction or maintenance staff. We focused on pavement preservation work, because it is the most likely to use either construction or maintenance contracts.

Audit Objectives

We established six audit objectives:

1. Are similar types of projects assigned to construction and maintenance staff?
2. Is the pavement preservation project assignment process reasonable?
3. Is project cost considered when deciding to assign a project?
4. Do scope of work differences warrant the use of two contracting approaches?
5. Are the differences in testing and contract oversight reasonable?
6. Do controls assure Pavement Management System (PvMS) data is useful for project decisions?

Chapter I - Introduction

To consider these objectives, we reviewed three options for completing highway pavement preservation work:

- < MDT maintenance.
- < Maintenance contracts.
- < Construction contracts.

Audit Scope and Methodologies

We examined the processes used by MDT officials to:

- < Identify candidate highway projects/segments for pavement preservation projects.
- < Allocate pavement preservation funding to construction and maintenance functions.
- < Prioritize, select, and schedule pavement preservation projects for funding and completion.
- < Solicit bids and award contracts.
- < Verify project/product quality.

For each of these categories, we looked at decision-making roles to examine consistency and determine whether processes work as intended. We generally looked at documentation and activities for fiscal years 1998-99 through 1999-00.

Scope Exclusions

We excluded:

- < Major highway rehabilitation and construction projects accomplished through contracts administered by construction staff, because the funding used for these projects is outside of the pavement preservation program.
- < Review of other maintenance activities such as plowing snow, sanding, mowing, weed control, etc.
- < Evaluation of the need for the department to improve utilization of maintenance and construction staff based on workload cycles. The department is currently reviewing alternatives.

Methodologies

We reviewed Titles 18 and 60, MCA, regarding state contracting requirements for highway maintenance and construction. We also reviewed applicable Administrative Rules of Montana and MDT policies and procedures.

We examined budget and expenditure documentation to identify pavement preservation program growth and to determine if funding was spent where and when it was allocated.

We interviewed Helena MDT officials from the Engineering, Maintenance, Transportation Planning, and Administration Divisions to identify the roles of officials in the decision-making process used to determine when a project is assigned to construction or maintenance.

We visited all five department transportation districts and met with officials from ten maintenance areas. We interviewed district staff including: District Administrators, Engineering Services Supervisors, Construction Supervisors, and Maintenance Chiefs to discuss the decision-making process, identify procedures, and outline the result of the process. We discussed recent construction and maintenance pavement preservation projects, the contracting process used, and the impact of factors such as environmental issues, right-of-way, special permits, and day-to-day weather.

We reviewed construction and maintenance pavement preservation contracts to compare differences and similarities in specifications and language. We also identified department criteria for project administration and oversight of pavement preservation contracts.

We visited pavement preservation project sites and observed activities related to quality assurance and contract administration to identify process similarities and differences when construction and maintenance options are used. We examined construction and maintenance pavement preservation project files to review documentation of project oversight, quality assurance, and testing, as well as the data used to finalize project payments. We also

Chapter I - Introduction

reviewed available cost/expenditure information to identify common and unique costs for each type of project/contract.

We interviewed Federal Highway Administration (FHWA) officials to determine if Montana's approach is comparable to other states, to discuss funding issues, and to identify concerns about the two processes (construction and maintenance) used to qualify for federal funding. We also contacted the Montana Contractors Association to solicit issues and concerns related to pavement preservation projects from the contractor perspective.

We reviewed the 1998 Construction Contract Administration Performance Audit report and work papers to outline initial concerns associated with assigning similar projects using the construction approach and the maintenance approach.

We examined data collection and input procedures associated with development of the annual Pavement Management System report to verify controls and report accuracy.

Compliance

The focus of this performance audit was to examine the decision-making process used by MDT to assign pavement preservation projects to district construction and maintenance staff. As a result of our review, we did not identify any non-compliance with statutes or rules.

Chapter II - Background and Funding

Introduction

In this chapter, we provide background on the Montana Department of Transportation (MDT) organizational structure to distinguish between the resources used for construction-designated pavement preservation projects and maintenance-designated pavement preservation projects. In addition, we discuss pavement preservation funding.

Background

According to Montana law, the legislature recognizes safe and efficient highway transportation is important to the state. Further, the statute indicates establishing and maintaining adequate highways, roads and streets, eliminating congestion, reducing accident frequency, providing parking facilities, are all part of ensuring safe and convenient transportation.

Section 60-1-103, MCA, defines construction as supervising, inspecting, actual building, and all expenses incidental to the construction or re-construction of a highway, including locating, surveying, mapping, and costs of the right-of-way or other interests in land and elimination of hazards at railway grade crossings. Maintenance is defined as the preservation of the highway, including surface, shoulders, roadsides, structures, and traffic control devices that are necessary for the safe and efficient use of the highway.

Pavement preservation is the term used by the department to define preventive highway work intended to increase the useful life of road segments. The department uses two approaches to complete pavement preservation projects. One approach involves the use of staff assigned to construction functions at the district level within the department. The other uses staff assigned to district maintenance activities. The scope of a pavement preservation project assigned to construction is usually more comprehensive than a project assigned to maintenance. For example, construction designated projects might include re-construction of shoulder slope or elimination of curves. Maintenance pavement preservation projects are restricted to work on the current road surface.

Chapter II - Background and Funding

Department Organization

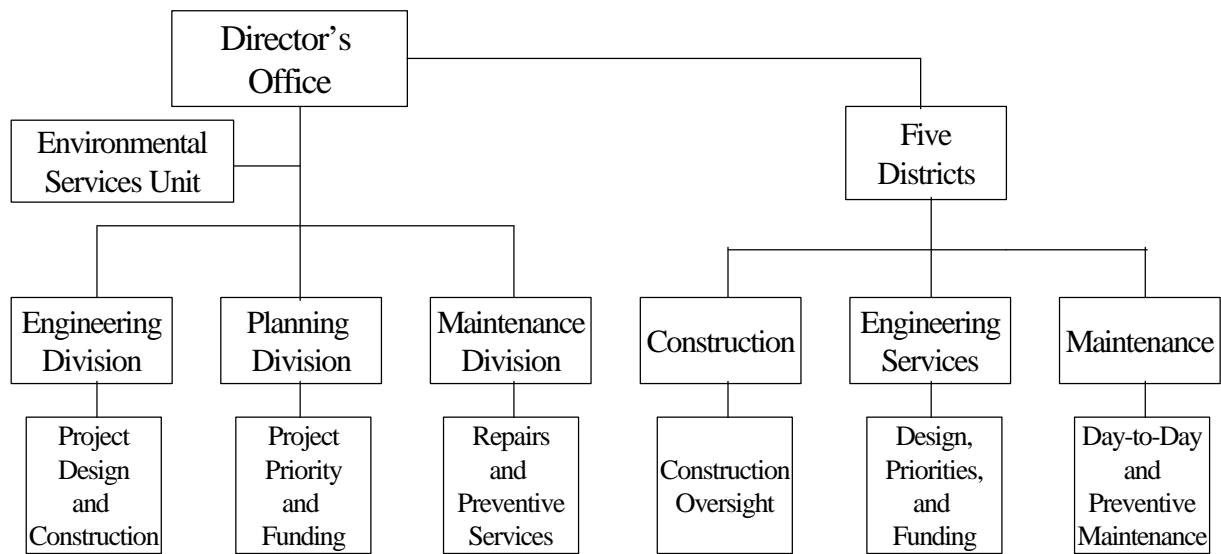
Within the Helena headquarters, construction responsibilities are placed with the administrator and staff of the Engineering Division. The administrator and staff of the Maintenance Division are responsible for providing for repairs and preventive services on Montana highways. The Transportation Planning Division administrator and staff assist engineering and maintenance staff at the headquarters and district levels identify and prioritize projects and provide information on project funding.

District Organization

Day-to-day oversight of highway construction and maintenance activities is the responsibility of officials located in the department's five transportation districts. District headquarters are located in Missoula, Butte, Great Falls, Billings and Glendive. Each district is supervised by a district administrator. The district construction supervisor and an engineering services supervisor are responsible for construction project oversight and project planning for the highway system within each district. Districts are divided into two maintenance areas, except for the Glendive District, which has three areas. Maintenance oversight, including day-to-day work and preventive projects are the responsibility of area maintenance chiefs. The following figure shows the department's pavement preservation organizational structure.

Figure 1

Organizational Structure
Department of Transportation



Source: Prepared by the Legislative Audit Division from department records.

Chapter II - Background and Funding

Pavement Preservation Funding

The department recently established an annual target of \$55 million for pavement preservation activities. This target or goal was determined from analysis of the department's Pavement Management System (PvMS) data and is considered an average necessary to meet annual needs. Pavement preservation funding is used for both construction-designated and maintenance-designated projects. The actual number of projects and the amount expended for pavement preservation varies from year to year depending on district highway needs, the status of project planning, project size/complexity, and available funding. The following table shows the total number of completed construction and maintenance projects for fiscal years 1998-99 and 1999-00.

Table 1
Completed Construction and Maintenance
Pavement Preservation Projects
(Fiscal Years 1998-99 and 1999-00)

<u>FY</u>	<u>Construction</u>	<u>Maintenance</u>
1998-99	49	91
1999-00	31	67

Source: **Compiled by Legislative Audit Division
from department records.**

The data shows maintenance typically completes more projects. However, construction projects are more comprehensive in terms of the amount of work. While most construction-designated projects include rebuilding of road structure, maintenance projects are generally restricted to chip sealing, crack filling and pavement overlays. The following table shows the number and type of maintenance preservation projects completed for fiscal years 1998-99 and 1999-00.

Table 2
Number and Type of Maintenance Pavement
Preservation Projects
(Fiscal Years 1998-99 and 1999-00)

<u>FY</u>	<u>Total</u> <u>Projects</u>	<u>Chip</u> <u>Seal</u>	<u>Crack</u> <u>Fill</u>	<u>Overlay</u> <u>Projects</u>
1998-99	91	54	6	31
1999-00	67	31	18	18

**Source: Compiled by Legislative Audit Division
from department records.**

Construction Pavement Preservation Funding

The total construction project budget for the department exceeds \$250 million for the year. The construction budget dedicated to pavement preservation projects averages around \$45 million each year. Most construction pavement preservation projects are funded through federal reimbursement. When federal funding is used, a match of state funds ranging from eight to thirteen percent is required. In order to qualify for federal funding, projects must meet criteria outlined in a project nomination agreement jointly developed by the Federal Highway Administration (FHWA) and the department. Interstate system, national highway system, and Montana primary and secondary roads, can all qualify for federal funding. Federal criteria requires proposed treatments to extend the useful life of the segment, and the intent is to use available funding for “observed pavement distress” rather than scheduled rehabilitation activities. Projects should move from development through completion in one to two years. Further, treatment decisions must be based on PvMS data. Nomination agreement criteria includes limitations on milling depth and overlay leveling layer as well as specifications for a final overlay thickness, road width, safety, and guard rail requirements.

Chapter II - Background and Funding

Highway segments which do not qualify for federal reimbursement are funded completely with state funding. We noted planning documents for FY 2000-01 indicate three projects have been selected for 100 percent state funding. The following table shows construction pavement preservation funding and state-federal shares for fiscal years 1998-99 through 2000-01.

Table 3
Construction Pavement Preservation Funding
(Fiscal Years 1998-99 through 2000-01)

<u>FY</u>	<u>Total Funding</u>	<u>State Funding</u>	<u>Percent</u>	<u>Federal Funding</u>	<u>Percent</u>
1998-99	\$45.3	\$13.0	29	\$32.3	71
1999-00	\$50.4	\$10.5	21	\$39.9	79
2000-01	\$58.9	\$8.2	14	\$50.7	86

Note: In millions of dollars.

Source: **Compiled by Legislative Audit Division
from department records.**

Increased availability of federal highway funding in recent years means more state funding is used as a match to receive the federal assistance. The increase in federal funding has also impacted the number of construction pavement preservation projects completed with 100 percent state funding. From fiscal year 1998-99 through 2000-01, the number of 100 percent state-funded construction pavement preservation projects is projected to decrease from 21 to 3.

Maintenance Pavement Preservation Funding

The total maintenance budget is approximately \$75 million. For fiscal year 1999-00, the department designated over \$14 million for maintenance pavement preservation activities. This funding was allocated to the five districts and eleven maintenance areas based on their review of road segment needs by district and area officials. Approximately \$9 million of the \$14 million was state funding. State funding for maintenance provides the department with the

Chapter II - Background and Funding

capability to respond to short notice requirements without the need to comply with federal contracting requirements.

Maintenance Funding Includes Federal Money

For the first time, in fiscal year 1999-00 FHWA approved the use of federal funding for maintenance activities. According to department officials, the assignment of department responsibility over paved secondary roads by the 1999 Legislature resulted in a search for additional funding sources. The FHWA agreed to limited use of federal funding for maintenance and authorized reimbursement of up to \$4.9 million.

Expenditures Limited

Only \$.5 million of the \$4.9 million of federal funding was expended in fiscal year 1999-00. According to staff, under-expenditure resulted from the process being new and the need to develop procedures for using a purchase order/contract which complied with federal requirements. As a result, federal expenditures were limited to materials such as de-icer fluid, gravel stockpiles, and road oil. Although federal funding was under-expended, the limited use of federal funding for stockpile materials allowed the department to use available state funding to meet on-the-road requirements.

The federal funding approved for fiscal year 1999-00 can be used in subsequent years. When combined with an additional \$6 million in federal funding designated for fiscal year 2000-01, approximately \$10.6 million total federal funding is available. To increase expenditures for fiscal year 2000-01, the Maintenance Division administrator allocated a share of federal funding to each district and maintenance area. Plans indicate expenditures for fiscal year 2000-01 will include more material stockpiles as well as projects such as chip sealing and crack filling. In conjunction with the FHWA, the department established maintenance contracting procedures to increase the use of federal funding and to comply with federal contracting requirements. Department officials indicated expansion of the use of federal funding for maintenance projects beyond the amounts approved for FY 1999-00 and 2000-01 is not anticipated because eligible federal projects are already maximized. In order to comply with federal requirements for pavement overlay projects, the

Chapter II - Background and Funding

contracting and oversight process would essentially duplicate the process already in place and used by construction and engineering staff.

Federal Contracting Requirements

Construction contracts incorporate requirements to allow federal aid reimbursement such as environmental review, non-discrimination, Davis-Bacon Act minimum wage criteria, field testing for quality assurance/acceptance testing, and project completion/cost estimate and reconciliation procedures. To ensure administrative consistency and federal reimbursement is as timely as possible, the department processes all construction-designated federal funding candidate projects the same whether a pavement preservation or major construction project and whether the project qualifies for federal funding or is state funded.

Montana Use of Federal Funding for Maintenance is Unique

Discussion with a FHWA official indicated Montana is taking the lead nation-wide regarding the use of federal funding for maintenance projects. FHWA is not concerned about the low expenditures for FY 1999-00 because they recognize the need for maintenance staff to become acquainted with new contract administration and project oversight procedures not previously required for maintenance when only state funding was used. The official expects the learning curve to extend for two or three years while staff refine procedures.

Maintenance Pavement Preservation is Split Between In-House and Contract

Department staff described two types of maintenance workload: preventive and reactive. We noted about half of the state funding designated for maintenance pavement preservation is used for reactive work. Reactive maintenance funding is part of pavement preservation funding, because the work is similar to pavement preservation work and buys time until a more comprehensive project can be developed. Reactive maintenance is based on the need for a fairly immediate response to make a road safe and generally includes pothole and rut patching, chip sealing, crack filling, and paint striping. Reactive maintenance work is accomplished using in-house maintenance resources (staff and equipment) and contracts.

Chapter II - Background and Funding

The department does not own or operate equipment required for pavement overlay such as milling or paving machines. As a result, pavement overlay projects are not accomplished using MDT maintenance resources. Maintenance contracts are used when a pavement overlay project is designated for maintenance. In addition, maintenance staff are responsible for day-to-day reactive maintenance work. Due to time limitations, projects such as chip sealing and crack filling may be awarded to contractors to meet annual needs. The following table reflects maintenance pavement preservation expenditures for fiscal years 1997-98 through 1999-00 distinguishing between MDT maintenance and contract projects. When MDT maintenance resources are used, the majority of project costs are associated with materials purchased using the contract process. Table 4 also identifies these MDT maintenance project material expenditures.

Table 4
Maintenance Pavement Preservation Expenditures
(Fiscal Years 1997-98 through 1999-00)

<u>FY</u>	<u>MDT Maintenance</u>		<u>Project</u>	<u>Total</u>
	<u>Labor/Equip</u>	<u>Materials</u>	<u>Contracts</u>	
1997-98	\$2.2	\$4.1	\$7.1	\$13.4
1998-99	\$2.1	\$4.7	\$8.9	\$15.7
1999-00	\$1.8	\$4.2	\$8.8	\$14.8

Note: In millions of dollars.

Source: Compiled by Legislative Audit Division from department records.

Chapter II - Background and Funding

Summary: Use of Federal Funding for Maintenance Projects

We noted the following points:

- < To qualify for federal funding, projects must meet FHWA criteria. Contract complexity and project cost increase as a result of federal requirements.
- < Maintenance expenditures using federal funding are limited to stockpile materials and low complexity projects such as chip sealing and joint filling.
- < Maintenance use of federal funding for pavement overlay projects would duplicate the contracting approach already used for construction projects.

Compared to fiscal year 1999-00, FHWA and department officials expect some increase in the use of federal funding for maintenance activities. However, significant increases are unlikely because the amounts of stockpile materials and the number of chip seal and joint fill projects needed each year are limited. Expanding the maintenance use of federal funding to more complex pavement overlay projects would duplicate the approach used by construction and result in higher total project costs.

Chapter III - Pavement Preservation

Decision-Making Process

Introduction

Highway pavement preservation work can be accomplished through either district construction or maintenance organizations. In this chapter, we discuss the decision-making process used by the department to determine whether construction or maintenance will be assigned to oversee a specific highway segment project. Three audit objectives identified in Chapter 1 relate to the decision-making process and are addressed in the following sections.

During the audit, we asked district officials how highway segments are identified for pavement preservation work and how the segments are selected for assignment to either construction or maintenance for administration and oversight. Based on their input, we identified a list of eleven factors used consistently by district and central office officials. We found consideration of these eleven factors was part of the decision-making process in all five districts.

Eleven Decision-Making Factors

1. On-site Observation. Generally this involves maintenance staff at district, area, or section level, but concerns about a road segment deteriorating may be initiated based on observations from any MDT staff as well local government officials and citizens.
2. Pavement Life Cycle Review. District and headquarters staff described the need for preventive maintenance activities to extend the useful life and to preserve the integrity of a highway for an optimum length of time. For example, to preserve new pavement, chip sealing is required. About one year later, crack/joint filling is necessary. Four years later, another chip seal is required to reduce deterioration. These activities prolong the life of the pavement. Deferral of preventive treatment allows water to penetrate below the surface and degrade the road structure. According to district staff, consideration of where a segment is in the pavement life cycle is fundamental to determining pavement preservation needs.
3. Pavement Management System (PvMS) Report. PvMS road condition data is compiled annually by MDT Engineering Division staff. When projects are completed by maintenance and construction during the year, the system is updated for the next report. PvMS is designed to consider road condition, then

Chapter III - Pavement Preservation Decision-Making Process

recommend a preventive treatment strategy. PvMS data includes on-site evaluation of three aspects of pavement condition:

- < Road profile measurements to identify ruts and establish ride comfort.
- < Visual distress survey to identify cracking and fractures.
- < Non-destructive testing to measure the level of road structure failure and water damage.

4. Planning Documents. We identified two primary planning documents used in decision-making: 1) the Statewide Transportation Improvement Program (STIP) document (three year projection), used to forecast funding levels by district for each highway category (interstate, national highway system, state primary and state secondary), and 2) the tentative construction schedule included in the department's "Red Book" (five year projection) used to reflect funding obligation by project. These documents are used by staff to develop more detailed schedules such as program planning guides and annual pavement preservation lists. Other planning documentation included variations of highway segment maps reflecting the most recent work and in some cases scheduled projects and annual maintenance plans.
5. Funding Availability. The \$55 million target for pavement preservation is allocated between construction and maintenance functions. Construction staff are notified of a target allocation for pavement preservation. However, designation of funding for a specific project is centrally controlled in Helena. If a project in one district is delayed, another district's project could be substituted to utilize available funding. The Maintenance Division pavement preservation budget is allocated annually to the eleven maintenance areas based on a statewide assessment of highway needs.
6. Project Cost. Review and comparison of the potential cost of one option versus another is usually not a factor which determines the assignment outcome, because the other factors make the distinction between the need to use construction and maintenance resources. The primary exception to this is projects such as chip sealing that do not require design or extensive testing and monitoring. As long as no other factor has a significant impact, the lower cost option is usually selected for

Chapter III - Pavement Preservation Decision-Making Process

chip sealing. Following assignment of the project to construction or maintenance, both contracting processes select the lowest qualified bidder.

7. Environmental, Permits, and Right-of-Way. Typically, if a project requires an environmental review, a permit for wetlands or water quality, or purchase of right-of-way, it will not be assigned to a district maintenance organization for a contract. These issues usually involve the need for road design work and result in long-term projects and are assigned to construction.
8. Geometric Re-design and Upgrades. Road segments requiring re-design for such things as widening, shoulder slope, or elimination of curves, are designated for construction. Other upgrades such as guardrails, culverts, and bridge approaches also fit into this category. Construction and maintenance technicians can remove a strip of pavement to examine the underlying road base to determine the need for redesign and re-build, influencing the decision to use construction or maintenance resources.
9. Safety and Traffic Data. The department tracks road segment accident rates and accident cluster areas. If hazard removal is necessary, typically re-design is required and the project is assigned to construction. The department also analyzes highway segment traffic density to help determine an appropriate treatment approach.
10. Construction and Maintenance Resource Capability. District construction and maintenance staff are responsible for many activities and their capability to administer pavement preservation projects varies depending on priority workloads in all areas. In addition to oversight of pavement preservation contract projects, construction crews are responsible for major re-construction projects and survey and design work for future projects. During the summer construction season, maintenance crews are also responsible for mowing, guardrail repair, patching pot holes/ruts, weed control, and bridge repair. These factors all influence chip seal, crack filling, and pavement overlay project priorities and timing.
11. Local Government Influence. Local government officials play a role in the decision-making process because they are aware of growth patterns and constituent concerns.

Chapter III - Pavement Preservation Decision-Making Process

Performance Program Process

For the future, the department is in the process of implementing a new decision-making tool, known as Performance Program Process or P³, to help identify and prioritize highway projects to “develop an optimal investment plan.” This tool uses existing department management data (pavement, congestion, safety, and bridges) to identify achievable highway system quality and an optimal mix of funding levels by type of work (pavement preservation, rehabilitation, and reconstruction). P³ is being used to re-examine projects already scheduled and funded for 2001 through 2004, but is intended to be fully implemented and used as a tool for identifying needs and establishing priorities for projects anticipated from 2005 and after.

P³ is not designed to pick specific projects for management. Rather it is intended to be a tool to guide the highway construction project nomination process. District staff will still be responsible for considering many of the factors identified in the previous section as part of the decision-making process. Department officials expect use of P³ will more formally document the integration of the varied management system information leading to decisions reflecting construction and maintenance project priorities. In addition, P³ has been designed to help staff measure progress towards achieving transportation system goals.

In the following sections, we discuss the audit objectives related to the current decision-making process.

Objective #1: Are Similar Types of Projects Assigned to Construction and Maintenance Staff?

During the 1998 audit of MDT Construction Contract Administration, contractors indicated the department was administering similar types of projects in a dissimilar manner using different entities (construction and maintenance). This was a concern because it appeared projects administered by construction staff were held to a different standard than projects administered by maintenance staff. To assess this concern, we developed an audit objective to examine project similarity.

Most pavement preservation projects tend to “look” similar to the public. For example, a .15-foot overlay using a maintenance

Chapter III - Pavement Preservation Decision-Making Process

contract looks like a .15-foot overlay using a construction contract. The eleven factors identified above are used for the decision regarding project assignment to district construction or maintenance staff. The use of these factors makes the projects different. There are obvious project differences such as safety issues requiring re-design. For example, a new shoulder associated with a construction contract for pavement overlay would not look the same as a maintenance overlay contract without any shoulder work. Other factors such as funding source are not so obvious. Since state funding is limited, the department uses available federal funding whenever possible. Given this situation, if an overlay can be funded with federal money, the decision might be to prepare a construction contract to allow for federal reimbursement. When the decision is made to use federal funding, then the scope of the project might be expanded to incorporate additional work to upgrade the highway segment.

Construction-Administered Projects

Generally, department officials expect construction projects to achieve “more” than a maintenance project. This often includes highway system upgrades such as:

- < Improving the structure or design of the road bed,
- < Widening, straightening curves to increase vision,
- < Extending shoulders,
- < Adding guard rails, or
- < Replacing culverts.

Because of the expanded scope of work, construction projects are expected to last longer providing more pavement life, assuming adequate preventive maintenance after the project is complete. While staff recalled one or two examples of construction pavement preservation projects which did not meet the longevity expectation, these were the exception. Staff believe construction quality and product longevity expectations are usually met.

Chapter III - Pavement Preservation Decision-Making Process

Maintenance-Administered Projects

When the decision is made to assign a project to a district maintenance organization, the focus is to:

- < Use the most expedient process because of road deterioration,
- < Buy time until a construction project could be scheduled and funded, or
- < Limit the amount of work, because traffic density is low and safety improvements are not part of the project.

Inherent in these decisions is acceptance of the risk that quality will be impacted. However, most maintenance pavement preservation contract overlay projects result in high quality and are comparable to construction overlays. Staff recalled maintenance projects initially completed to buy time until a construction project could be scheduled. However, the maintenance project negated the need for the construction project. When maintenance resources are used, staff accept that improvements such as road bed structure, widening, changing curves to increase vision, extending shoulders, adding guard rails, or replacing culverts will not be done. If there is a serious safety issue, officials indicated it would be the overriding factor and a construction project would be scheduled.

Quality is Consistent

Maintenance staff, like construction staff, achieve a consistent level of quality for a couple of reasons. First, maintenance staff use some of the same testing techniques required for construction projects. For example, testing at a hot mix plant for a maintenance contract routinely incorporates the same laboratory trailer and staff used for a construction contract. Second, according to district officials, essentially the same contractors supporting construction projects are used for maintenance projects. Sometimes, one hot mix plant supports maintenance and construction contracts at the same time and the quality is essentially the same. The expectation is the construction influence helps assure a consistent level of maintenance quality.

Chapter III - Pavement Preservation Decision-Making Process

Conclusion: Though similar, projects are not the same.

We conclude construction and maintenance pavement preservation projects though similar in appearance, are not the same. The scope of work differs and the factors used to make the assignment decision are not the same. The mission and goals of the construction and maintenance functions are different, which means the outcome of the projects is expected to be different. Differences do not necessarily infer lower product quality; rather, differences only infer the willingness of management to assume additional potential risk.

Objective #2: Is the Pavement Preservation Project Assignment Process Reasonable?

According to department officials, Montana's highway segments range from modern designs capable of sustaining high density traffic, to structures not originally designed for current traffic loads. The MDT strategy is to improve the segments in poor condition, while maintaining those in good condition through preventive measures. In order to achieve this balance within the constraints of available resources and funding, officials use the eleven factors discussed earlier. We developed an example to show how these factors affect the decision-making process.

Decision-Making Example

Following spring thaw, a maintenance superintendent identifies a road segment deteriorating from winter frost and freezing cycles. Engineering and maintenance staff review the PvMS report, which reflects the segment is cracking beyond limits for crack and joint filling and indicates the road will require re-construction, including pavement overlay. District staff examine department and district planning documentation and note a construction project is already in the design phase. A review of funding indicates both state funding for maintenance and federal funding for construction are available. However, environmental and right-of-way requirements suggest the construction approval process cannot be accelerated, and a contract is at least three years away. Test strip analysis reveals the road base is adequate. Review of the Safety Management System indicates there are no specific accident trends associated with the segment and average daily traffic data indicates the segment is low density.

In consideration of options, staff determine adequate maintenance resources are available. Another highway segment within a few

Chapter III - Pavement Preservation Decision-Making Process

miles is scheduled for re-construction during the summer and the contractor will operate a hot mix plant as part of the project. A district crushed gravel stockpile is available in the vicinity and can be used. District supervisors are aware local officials also consider the segment a high priority.

Options for Overlay

Since the department does not own or operate milling or paving machines, in-house maintenance is not an option. That leaves two options for this pavement preservation example: either a construction contract or a maintenance contract. Since the construction contract project is at least three years away, district officials decide to use a maintenance contract. According to district staff, a pavement overlay of .15 foot or about 2 inches will meet the needs and no other design work is necessary. As a result, the area maintenance chief prepares a project material and cost estimate for an overlay on the highway segment. The estimate is forwarded to Helena for bidletting and contract award. The project is funded with the district's maintenance allocation for pavement preservation (state funding).

Different Factors - Different Decision

If any of the factors considered in our example were different, staff might make a different resource decision. For example, if only federal funding were available or if the safety data indicated a severe accident trend and only re-design and construction would solve the problem, the department might attempt to expedite the construction process. However, expediting construction contracts is difficult because of the complexity associated with resolving environmental, funding, and right-of-way issues. In-house maintenance resources could be used to patch the worst sections of the road segment to buy time until the construction contract could be awarded.

Trade-Off Between Construction and Maintenance is Necessary

According to district officials, it is not unusual for a project to be identified as a candidate for construction, then designated for maintenance on an interim basis. If the road would most likely deteriorate beyond acceptable safety levels, or deteriorate to a point requiring significantly more re-design and construction by the time the construction project could be designed, awarded and construction started, an interim maintenance project could be established to

Chapter III - Pavement Preservation Decision-Making Process

maintain acceptable conditions. Factors such as environmental reviews, utility relocation requirements, right-of-way limitations, or available funding could all influence the decision to proceed with a maintenance contract project to “buy the department enough time” to plan and design an appropriate construction project. A more timely, but less complex and expensive maintenance project can provide a serviceable road for the interim period.

Conclusion: Decision-making process is reasonable.

We concluded the decision-making process used by the department for pavement preservation projects is reasonable. The factors considered in the process allow staff to distinguish between projects warranting assignment to construction or to maintenance. Federal contracting and oversight requirements significantly influence decision-making.

Objective #3: Is Cost Considered when Deciding to Assign a Project?

During the 1998 audit, contractors indicated the cost associated with projects administered by construction staff was higher than costs for maintenance-administered projects. We identified project cost as one of the eleven decision-making factors. However, we noted cost generally only influenced the assignment decision for low complexity projects such as chip sealing.

Cost Factors Vary

We found there are many factors which make cost comparison impractical.

- < Grade of the aggregate used for maintenance and construction projects can vary depending on pavement design.
- < Asphalt cement and emulsified asphalt can be purchased from different refineries/sources, and is available in different specifications. Data shows pavement material costs can range from \$20 to \$60 per ton.
- < Amount of hydrated lime and the mix formula is not the same, depending on the grade of the aggregate and asphalt.
- < For maintenance contracts, sometimes the contractor crushes the aggregate on-site, other times, the contract calls for the use of an existing MDT maintenance stockpile.

Chapter III - Pavement Preservation Decision-Making Process

- < Contracts using federal funds adhere to Davis-Bacon Act requirements, increasing project costs.

A review of traffic control provides an example of how cost can differ between projects administered by construction and maintenance organizations. The department uses one standard handbook for traffic control and the standards allow flexibility depending on the level of control desired. For construction, most projects are long term (weeks or months) and the goal is to keep traffic moving at a specific pace. Contractors are required to address the entire construction segment (possibly 10 to 12 miles) to maintain a flow pattern consistent with the standard handbook criteria and the total hazards represented.

For maintenance, the project could cover a segment similar to construction, but the projects are usually short duration (few days). The hazard zone may only include a few hundred yards at a time. The purpose of maintenance traffic control is to move traffic safely past the hazard. Staff indicated while both approaches comply with highway safety standards, the costs will be different because the construction approach requires more labor and equipment.

Conclusion: Cost review is adequate.

We concluded the department does consider cost, particularly for less complex projects such as chip sealing. However, as a result of our examination, we decided it is not necessary to expand review of cost beyond the current level, because for most projects the significance of the other ten decision-making factors is more important.

Chapter IV - Contracts and Data Accuracy

Introduction

In this chapter, we provide discussion and assessment of the final three audit objectives identified in Chapter I. These objectives consider the different types of contracts, contract oversight activities, and the accuracy of Pavement Management System (PvMS) data.

Statute Provides for Two Contract Options

Section 60-2-110, MCA, requires the state Transportation Commission, in consultation with county commissioners and local governments, to establish priorities and select and designate segments for construction. The department is required to make recommendations to the commission and establish procedures for administering construction and re-construction projects. According to section 60-2-112, MCA, the commission is generally required to let construction and re-construction contracts through competitive bidding. For highway maintenance contracts, purchasing law, section 18-1-102, MCA, provides the criteria and also requires the department to award contracts to the lowest bidder for the purchase of goods and for construction, repair, and public works of all kinds.

In the following sections, we present conclusions for each audit objective. Our review of pavement preservation contracting and oversight activities and procedures resulted in the development of one audit recommendation related to maintenance testing and documentation.

Objective #4: Do Scope of Work Differences Warrant the Use of Two Contracting Approaches?

Construction Contracts

Construction project development through contract award for pavement preservation projects generally follows a standard sequence:

- < Project identification by district staff (Winter).
- < District nomination to Transportation Planning Division for funding (Spring).

Chapter IV - Contracts and Data Accuracy

- < Project design by district staff (Spring).
- < Review by Construction Bureau staff (Spring/Summer).
- < Statewide Transportation Improvement Program review, contract advertising, and Transportation Commission approval (Fall).
- < Contract award by the Contract Plans Section (Fall).

The cycle for a construction pavement preservation project takes about 1 to 1½ years assuming no significant environmental, permitting, right-of-way, or funding issues. Construction contracts reflect specifications for project activities such as traffic control, excavation, grader work, and striping, as well as materials such as cover material, hydrated lime, liquid asphalt, and emulsified asphalt. Project design documents address the road sub-surface, shoulders, guard rails, pavement, turnouts, and curbing.

Maintenance Contracts

The maintenance contract process begins with a project cost estimate prepared by a district maintenance chief. This is submitted to the Maintenance Review Section in Helena, then forwarded to the Purchasing Services Bureau for bid requests and bid award. The bureau notifies the district of the low bidder and prepares a standardized purchase order contract. The majority of the maintenance contract is boilerplate language referring to general specifications. Project specific language reflects requirements such as identification of the road segment, width, length, type and amounts of materials (aggregate, oil, lime) required, and specific equipment requirements.

The contract award process can take as little as six to eight weeks. This compares to a year for construction pavement preservation contracts and often several years for major construction projects. According to staff, the capability to expedite a maintenance contract provides a level of responsiveness needed by the department to assure a safe highway system. The Transportation Commission does not review/approve maintenance projects. However, maintenance budget allocated to pavement preservation is part of their annual

Chapter IV - Contracts and Data Accuracy

STIP review. When federal funding is available for maintenance pavement preservation projects, the contract has to include federal requirements similar to construction contracts. The following figure summarizes the differences between the construction contract process and the maintenance contract process.

Figure 2
Summary of Construction and Maintenance
Contract Process

<u>Category</u>	<u>Construction</u>	<u>Maintenance</u>
Project Development	District Staff	District Staff
Project Review/Approval	Transp. Commission	Maint. Division
Project Design	Engineering Design	Project Estimate
Processing Time	12 Months	60 Days
Specifications	For Each Activity	General
Federal Requirements	All Federal Contracts	Not required if state-funded

Source: **Compiled by the Legislative Audit Division
from department information.**

Project Schedules

For construction pavement preservation projects, contracts are usually awarded in the late fall. Therefore districts are aware in advance of the construction season when a project can be scheduled. Contracts reflect completion dates, and anticipated start dates are discussed during pre-construction meetings between staff and contractors. The number of construction projects in each district varies considerably from year to year depending upon highway system needs. Seven to ten pavement preservation projects are administered by district construction staff each year. Construction pavement preservation projects run from a few weeks to a few months in duration, but are usually completed in one construction season.

Maintenance pavement preservation project scheduling is less complex. Most maintenance areas provide contract administration

Chapter IV - Contracts and Data Accuracy

for three or four projects each year. This can mean one or two pavement preservation projects in the spring and one or two more during the summer. In addition staff are responsible for three or four in-house projects each year. Maintenance projects are short duration, typically only four or five days. Chip sealing and crack filling are less demanding in terms of the number of staff necessary for oversight compared to overlay projects. Contracts specify a completion date, the amount of material, and a production and delivery time (number of days). This approach allows the contractor to bid based on the latest start date to assure contract compliance.

Conclusion: Scope of work difference warrants two approaches.

We concluded the differences in the scope of work between construction-designated and maintenance-designated pavement preservation projects warrants the use of two contracting approaches. Again, federal funding contract requirements dictate many of the differences.

Objective #5: Are the Differences in Testing and Contract Oversight Reasonable?

We identified several differences in the types and amount of testing conducted for construction pavement preservation projects compared to maintenance pavement preservation projects. While we found many reasons for the differences including funding type, contract language, and the acceptable risk to project quality, staff suggested a fundamental reason for differences is total project cost.

Project Cost

Compared to construction projects, most maintenance contract pavement preservation projects are in the lower end of the cost spectrum. The expenditure for testing to assure quality is also lower compared to construction-designated pavement preservation projects. According to staff, in general it does not appear to be an effective use of resources and funding to increase the level of maintenance testing and quality verification to reduce the potential risk of lower quality. The marginal decrease in risk for a maintenance pavement preservation project achieved by incorporating construction-level testing and oversight would not be cost-effective. The following table shows the range of construction and maintenance project costs for fiscal years 1998-99 and 1999-00.

Chapter IV - Contracts and Data Accuracy

Table 5
Range of Costs for Construction and Maintenance
Pavement Preservation Projects
(Fiscal Years 1998-99 and 1999-00)

<u>FY</u>	<u>Construction Range</u>	<u>Maintenance Range</u>
1998-99	\$17,300 to \$4.6 million	\$16,200 to \$842,800
1999-00	\$74,500 to \$5.3 million	\$16,700 to \$687,500

Source: Compiled by Legislative Audit Division from department records.

Construction Contract Administration and Oversight

Construction contract administration relies on a system of contractor incentives and penalties. Construction contracts are evaluated based on monitoring/testing conducted by district MDT staff which measures whether a product (hot mix, crushed gravel, etc.) meets a range of specifications. The contractor is notified of the testing status and paid or penalized based on performance. For example, staff conduct compaction tests of the plant mix using an on-site surface tester, by sampling pavement from the hot mix plant, or taking a core sample from the construction site. The specification calls for a range of 93 to 97 percent compaction. Testing indicates where the product is within the range and is conducted throughout the project, possibly several times each day. Testing results are tracked and used by staff to calculate incentive or deductible payments made to the contractor. If test results are at the high end of the range, the contractor receives incentive payments (more money); if at the low end of the range, the department calculates deductibles and the contractor receives less money. Other items tested or monitored include:

- < Oil quality.
- < Gravel/aggregate mix (course versus fine mix).
- < Volume of materials (to assure proper mix).
- < Mix temperatures (plant and site).
- < Thickness of the overlay.

Chapter IV - Contracts and Data Accuracy

- < Number of compaction roller passes.
- < Calibration of scales.

Acceptance Testing for Construction Quality Assurance

In most cases, the department takes samples of material for “acceptance” testing to identify where the material fits within the specification outlined in the construction contract. If at some point the testing shows the material is completely out of the acceptance range, staff are authorized to shut down the operation and/or require material replacement. The contractor can choose to improve material quality. For example, if the aggregate mix (various sizes of crushed gravel) has more fine material relative to coarse material and the result is the low end of the acceptable range, the mix can be improved by reducing the fine material. Department construction staff do not direct the contractor to improve quality, they provide information allowing the contractor to make a quality-related decision.

Maintenance Contract Administration

The quality control approach for maintenance organizations is different. The contract identifies a materials specification (for example a grade of aggregate, oil, lime) and a final volume of plant mix pavement. Staff verify the grade of the aggregate or in some cases provide the material from previously purchased MDT stockpile. Through an initial mix design (laboratory analysis), the proper mixture of oil, lime and aggregate is determined, as is target density for compaction.

Maintenance staff monitor volumes of oil, lime and aggregate, plus the delivered mix to verify compliance with contract requirements. Staff also verify pavement thickness and compare this information to the calculations used to determine the contract volumes. Too thin means less pavement is being used than required and the quality will not be adequate; too thick means more pavement is being used than needed and the cost is increasing. Staff monitor the temperatures at the hot mix plant and the paving machine to be sure the product is applied properly. Maintenance staff tell the contractor when quality is not adequate and direct the need for correction. Maintenance staff also have the authority to shut down an operation if product quality is judged to be too low and not readily correctable. For example, staff can deny a truckload of hot mix if the temperature is not

Chapter IV - Contracts and Data Accuracy

adequate. The contractor is paid for the volume of material received and accepted by staff. Contractors do not have any incentive to produce a better than average quality product; the incentive is to produce an acceptable quality at the lowest cost. If maintenance staff accept the material, the quality is considered adequate.

Project Oversight - Contractor Payment

For construction projects, department staff determine quantities used for each contract item at various points during construction. Using this information, the contractor is paid for work throughout the project. For maintenance projects, contractors submit an invoice at the end of the project and following staff review and approval, the contractor is paid for the entire project.

Conclusion: Testing and oversight differences are reasonable.

We identified the primary differences between oversight of construction and maintenance pavement preservation projects as:

- < Type and number of tests per day (more for construction).
- < Volume of testing documentation (more for construction).
- < Project cost and associated cost of testing (higher for construction).
- < Potential risk to quality (higher for maintenance).
- < Contractor payment procedures (more detailed for construction).

Federal requirements dictate many of the construction contract testing requirements. Based on the expectations of construction pavement preservation projects compared to the projects assigned to maintenance, we concluded the differences in testing and oversight are reasonable.

Chapter IV - Contracts and Data Accuracy

On-Site Testing and Documentation Varied Between Maintenance Areas

We noted from district to district maintenance files reflected a wide variety in the amount and types of testing and support documentation. Staff indicated the variation of testing from area to area was based on individual experience and background. Some maintenance areas use standard forms developed for construction projects testing; others developed maintenance checklist forms; others maintain handwritten notes/diaries. We found maintenance staff consistently track product/material volumes because of the need for accuracy when reviewing and approving the contractor's invoice.

We found a variation in the amount of testing conducted by staff, but could not determine the influence on the quality of the final product. MDT officials indicated testing and documentation consistency is an area of concern, particularly as the department pursues more and more maintenance preventive work compared to the historical reactive (patching) approach. Our concern is either staff in one maintenance area are testing and documenting unnecessarily, or staff in another area are not providing enough verification of product quality. Department officials suggested the establishment of minimal requirements would improve consistency. Due to the size and complexity of most maintenance projects, we do not believe it is necessary for maintenance to test and document testing to the same degree as currently required for federally funded construction projects. It would not be a cost-effective use of staff resources and funding. We believe the combination of expertise currently available in all eleven maintenance areas could jointly establish quality control and testing standards for projects based on the type of work, material specifications, and final product.

Recommendation #1

We recommend the Maintenance Division establish quality control and testing standards for the testing and documentation of maintenance pavement preservation projects to verify quality.

Objective #6: Do Controls Assure Pavement Management System (PVMS) Data is Useful for Project Decisions?

Staff described PvMS as a starting point for the decision-making process for determining highway treatments for interstate, state primary and state secondary roads. The system was purchased in 1994 and uses an Oracle database to store road condition information collected by department staff. Highway segment surveys provide the information on road conditions. Information from visual surveys for cracking is manually recorded and loaded into the system. In addition, electronic information is collected from two sources: (1) laser equipment, which measures rutting; and (2) vehicle movement measurement devices, which assess ride comfort. The data is converted to four indices: rut, ride, alligator cracking, and miscellaneous cracking. These indices combine to create an overall pavement index. This index is processed through a treatment decision tree to determine a recommended treatment. Two treatments are proposed for each segment, one for construction and one for maintenance, because the system was designed to recognize interim maintenance treatments may be required while waiting for construction projects.

Controls are Reasonable

We found the controls in place to assure data accuracy appear to be reasonable. Staff document equipment calibrations to support collection accuracy. In addition, staff run system queries to verify data for each road segment is current and complete. System access is also limited to assigned staff. The department also implemented procedures allowing field staff to question specific segment condition information or recommended treatments and make revisions if appropriate. We noted field staff expressed consensus that PvMS reliability as a management tool was in the 85-95 percent range.

Conclusion: Data controls are reasonable.

We concluded data controls for PvMS appear to be reasonable. The information provided is an important part of the department's process for determining whether to assign projects to maintenance or construction. Neither district nor headquarters staff rely totally on PvMS for decisions; management officials consider the other ten decision-making factors before deciding on a treatment approach.

Agency Response

April 19, 2001

APR 24 2001

Jim Nelson
Performance Audit Manager
Legislative Audit Division
PO Box 201705
Helena MT 59620-1705


Dear Mr. Nelson:

Please pass along my thanks to the Legislative Audit Division and Tom Cooper for all the time and effort put forth in this audit. I think the format that was used in reviewing this particular subject went a long way in explaining and justifying the similar and different methodologies used by both the Engineering Division and the Maintenance Division.

We concur with the recommendation that was made that our Maintenance Division establish quality control and testing standards for the testing and documentation of maintenance pavement preservation projects to verify quality.

In fact, that process has already begun through our Maintenance Review Section as well as the addition of a contract writer and reviewer. Also, I've attached a copy of the Executive Summary of a Joint Application Development (JAD) session held April 4, 2001, as an additional component of MDT's compliance. The purpose for the JAD session was to study, recommend, and implement specific items for establishing quality control and testing standards for the testing and documentation of maintenance pavement preservation projects.

We are very interested in putting out a quality product, and are actively working toward that goal. We will implement this recommendation by July 1, 2001, in anticipation of this summer's paving season.

Sincerely,



David A. Galt
Director

enclosure

copies: John Blacker, Maintenance Administrator
Gary Gilmore, Chief Engineer
Dennis Sheehy, Internal Audit

Page 37

Maintenance Project JAD Session Executive Summary

On April 4, 2001, the Maintenance Division held a Joint Application Development (JAD) session to address tracking of Maintenance projects. The following individuals attended the session: Mike Bousliman, Jeff Sillick, Sandy Waddell, Brenda Johnson, Jon Swartz, George Swartz, Dick Clark, Cheryl Larson, Dave Hand, Dick Jackson, Jack Peaslee, and Jim Stevenson.

Five objectives were established for the session. These objectives included:

- To understand the current processes for Maintenance project nomination, selection, contracting, delivery, and review.
- To understand the potential needs and role of MDT's Project Management System (PMS) as it relates to Maintenance projects.
- To clearly define and improve the current business processes for Maintenance projects.
- To determine the requirements for a new MMS-based Maintenance project tracking system.
- To develop a system to track all phases of Maintenance projects and make all project details easily accessible.

The following definition for Maintenance projects was proposed for the session: Any substantial reactive, preventative, or routine Maintenance activity performed on highway pavements, performed by MDT forces or contracted. These activities would include contracted pavement preservation, MDT performed pavement preservation, and contract striping. Maintenance projects do not include contracted mowing, contracted rest area maintenance, and similar activities.

Seven business processes related to Maintenance projects were presented by various individuals. After each presentation, the group identified issues and problems associated with each of the business processes. The seven business processes covered included:

- Project Management System – Dick Clark
- Project Nomination Solicitation – Mike Bousliman
- Project Nomination Development – George Swartz
- Project Nomination Review – Jon Swartz
- Contract Submittal to Purchasing Services – Jon Swartz
- Pre-Construction Meeting – Dick Jackson
- Project Initiation, Delivery, and Review – Jack Peaslee

The following were the significant proposed solutions that arose from the JAD session:

- Develop an annual tentative Maintenance Project Plan system and make it available on the intranet and internet
- Develop a federal-aid guidelines manual for Maintenance field personnel

- Develop standard procedures for documenting project information
- Develop a Maintenance-based bid tabs system
- Develop a policy to allow funds transfer among Divisions
- Provide Maintenance Chiefs with monthly construction program status reports
- Develop an Oracle-based Maintenance project tracking system

The next steps in the process include:

- Forming a team to address specific issues and proposed solutions
- Outline a proposed Oracle-based project tracking system
- Obtain approval and funding for system development
- Develop and implement Maintenance project tracking system